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Histopathological Alterations in the Gills of Freshwater Fish, *Puntius ticto* on Exposure to Distillery Effluent

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Abstract

Fresh water fish Puntius ticto exposed to lethal concentrations (25% and 22% for 24h and 96h of LC_{50}) of distillery effluent, showed pronounced histopathological alterations in the gills, such as cloudy swelling in chloride and pillar cells. Fusion of secondary lamellae and blood hemorrhages at some places were also observed in 24h exposure. Fusion and cytoplasmic degenerations were also observed in secondary gill lamellae along with cell necrosis. Hypertrophy of epithelial cells with pyknotic nuclei have been noticed in pillar cells on 96h exposure.

Key words: Distillery effluent, histopathology, *Puntius ticto*

Introduction

Fast industrialization and urbanization, resulted into pollution in country which has reached to the peak of threshold limits. The aquatic organisms find it very difficult to cope up with the changing condition of water due to pollutants. Karuppasamy (1979) has shown that fishes are the most sensitive of all aquatic animals.

Gill is the respiratory organ of the fish, the cellular damage induced by the toxicant in terms of atrophy, bulging, hypertrophy, hyperplasia of interlamellar epithelia, necrosis and separation of epithelial layer of the secondary lamellae, might impair respiratory function by reducing respiratory surface area. Tissue hypoxia and disruption of respiratory function by reducing surface area. The spent wash discharged from Indian distillery industry contains high amount of potassium, calcium, chloride, sulphate. In addition to these, the low pH value, more organic load and high BOD are some of the other major problems due to distillery industrial wastewater. The high BOD causes depletion of dissolved oxygen and proves harm to aquatic life. Gills in fishes easily get damaged due to the exposure of different chemical toxicants present in industrial effluent. Moreover, gills are the vital organs and remains in contact with water.

Materials and Method

In the present study freshwater fish, Puntius ticto were collected from Kham river. The fishes were maintained in glass aquaria and were acclimatized for four weeks. Healthy fishes showing normal activity were selected for histological observation.

For the histopathological studies, series of diluted concentration of distillery effluents were prepared. The LC_{50} values for 24 to 96 hrs have been determined by probit analysis method for different concentrations. A batch for control was also maintained (10 fishes) simultaneously. Gills of exposed and controlled fishes were taken out for their pathological observations on termination experiments for respective toxicants. The tissues were immediately fixed in Bouins fluid for 24hrs and processed according to standard procedure. The blocks were prepared in paraffin wax and sections were cut on rotatory microtome to a thickness of 6 microns and stained using haematoxyline and eosin and mount in DPX.

Result

Fig.1. Structure of gill in normal condition

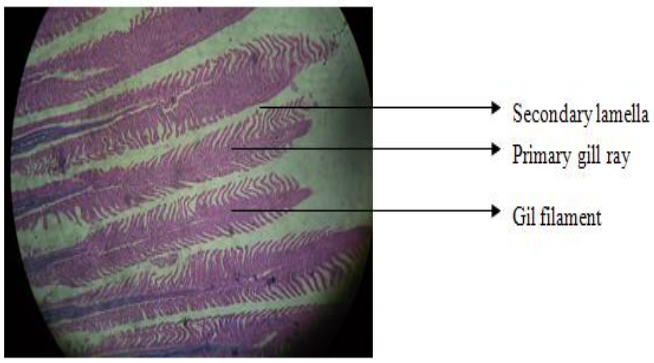


Fig.2. L.S. of gills after exposing at 25% of distillery effluent for 24h

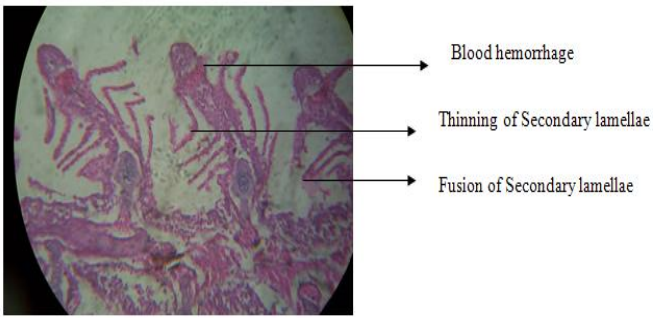
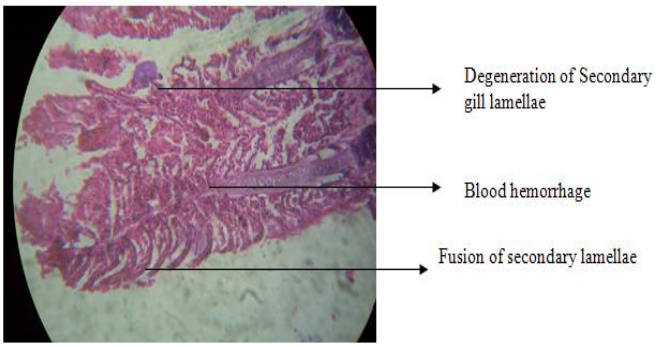


Fig.3. L.S of gills after exposing at 22% of distillery effluent for 96h



Normal gill structure

Gills are situated in branchial chamber on either side of the body in fishes. Each gill has a gill arch with double row of elongated laterally projecting gill filaments. These filaments are flat and leaf like and join at the base on gill rackers by a gill septum. Numerous

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semicircular, leaf like projections are lined up along both sides of the primary gill lamellae called as secondary gill lamellae (Fig. 1).

Histopathology

The fish exposed to lethal (LC_{50} for 24h. at 25%) concentration exhibits marked changes. Chloride cells and pillar cells showed cloudy swelling. Fusion of secondary lamellae was seen. Epithelial hypertrophy found in epithelial cells (Fig. 2)**.**

The fish exposed to lethal (LC_{50} for 96h.at 22%) concentration of distillery effluent exhibited marked changes, like fusion and degeneration were noticed in secondary gill lamellae. Hemorrhage in cells was also observed (Fig. 3).

Discussion

In the study, distillery effluent produces anthropogenic effects on the aquatic environment and responses of fish can be used as indicators of toxicants. A stress response is characterized physiological changes and effect of pollutant on fish is associated by acute and chronic toxicity tests (Heath, 1991).

In fish, gills are critical organs for their respiratory and osmoregulatory functions. Respiratory distress is one of the early symptoms of pesticide poisoning (Mc Donalds, 1983). According to Skidmore and Tovell (1972), in the gills these toxicants appears to break down the adhesion between epithelial branchial cells and the underlying pillar cells; this is accompanied by a collapse of the structural integrity of the secondary lamellae and subsequent failure of the respiratory function of the gills.

Haniffa and Sundharavadhanam (1984) observed partial destruction of gill epithelium pillar cells, acidophil mast cells, separation of epithelial layer of secondary lamellae from basement membrane, mucous cells destroyed and gill filaments were seen completely covered by thick mucous layer in distillery effluent treated *Barbus stigma*.

In the present study lethal concentrations (24hr to 96hr) of distillery effluent caused severe histopathological changes in the gills of fish *Puntius ticto,* like fusion of secondary gill lamellae, thickening of secondary gill lamellae, and swelling of pillar and chloride cells. At some places pyknotic condition was also observed in epithelial, chloride and pillar cells.

Wagh *et.al.,* (1985) studied the histopathological alternations in the gills of *Barbus ticto* after acute toxicity of cadmium sulphate, zinc sulphate and copper sulphate. Gill *et.al.,* (1988) reported histopathological changes in gills, of fish exposed chronically to methoxy ethyl mercuric chloride. Richmonds and Dutta (1989) studied histopathological changes induced by melathion in the gills of blue gill *Lepomis macrochirus*. Vijayalakshmi and Tilak (1996) observed necrotic changes and alteration in the gills of *Labeo rohita* after monocrotophos and fenevalerate and their mixtures.

The present study reveals that, the discharge of the distillery effluent would be deleterious to aquatic life even at low concentration. Further, it is suggested that the role of environmental education will help to make environment free from pollution.

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